

## BACKGROUND OF THE INVENTION

5 A standard aircraft Ethernet interconnect system (for carrying high rate bits between computer circuits on the aircraft) uses a special quad cable that has four individually insulated conductors and a grounded main shield around the conductors, and has a 100 ohm characteristic impedance. The four cable  
10 conductors are terminated to contacts of a Quadrax connector that is inserted into a bore of a specialized metallic insert having several bores and holding specialized contacts that connect the four Quadrax contacts to terminals. A common type of such terminals includes socket contacts that project from a connector that is mounted on a circuit board. The special metallic insert that receives the Quadrax connector is expensive.

15 A low cost header for connecting other pairs of contacts includes a plastic molded frame having multiple rows and columns of passages and a double-ended pin in each passage. The rear ends of the passages can receive terminals of a mating connector. It would be desirable if the front ends of the insert pins could electrically mate with the contacts of the Quadrax type connector. The much lower cost of the molded plastic insert would greatly reduce the cost of the Ethernet connector system.

## SUMMARY OF THE INVENTION

20 In accordance with one embodiment of the present invention, a connection system is provided for connecting insulated conductors of a quad cable to terminals, using an insert of the type that has a molded plastic insert frame with multiple rows and columns of passages that each holds a double-ended pin. The mating ends of the pins are engaged with the terminals, and the present invention provides means  
25 for connecting conductors of the quad cable to rear ends of the pins that lie within the insert frame.

Applicant provides a cable-connected quad terminator with four contacts surrounded by a terminator main shield. Rear ends of the terminator contacts are terminated to the four cable conductors, while mating ends of the terminator contacts project forward of the terminator main shield. Applicant also provides a backshell adaptor having through bores into which the quad terminator can be inserted, the adaptor having retainers that removably retain the quad terminator in a fully installed position wherein mating ends of the contacts and subshields around each contact, project forward of the backshell adaptor. The backshell adaptor has a front face lying facewise adjacent to the rear end of the insert, with the four projecting parts of the terminator contacts and the subshields projecting into four corresponding passages of the insert frame. Each contact projecting part engages a rear end of a pin lying in an insert passage to complete the connection.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following description when read in conjunction with the accompanying drawings.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded front isometric view of a connection system of the present invention.

Fig. 2 is a rear isometric view of the quad terminator of the system of Fig. 1, and also showing, in phantom lines, the rear shield of a prior art Quadrax connector.

Fig. 3 is a partial sectional view of the system of Fig. 1, with all parts fully connected.

Fig. 4 is a sectional view of the quad cable of Fig. 3.

Fig. 5 is a rear elevation view of the quad terminator of Fig. 2.

Fig. 6 is a rear elevation view of a portion of the insert of Fig. 1, and also including circles indicating the outlines of the terminator main shields of the quad connector of Fig. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a connection system 10 for connecting conductors of a Star Quad cable 12 to terminals 14 of a connector 16. Each terminal 14 lies within a miniature stainless steel subshield 20. Such connectors 16 are commonly used in Ethernet connection systems on aircraft, to carry high speed data signals between computer circuits. Previously, a special metallic insert was used with a special Quadrax connector that was terminated to conductors of the cable 12, to connect to the another Quadrax connector in a special metallic insert 14. Such special metallic inserts were expensive.

It has occurred to applicant that a Standard insert 30 of a type that includes a molded plastic frame 32 and multiple double-ended insert contacts, or pin contacts, or pins 34 might be used instead to make connections between the cable conductors and the terminals 14. The standard insert 30 is widely available at low cost and is commonly used as a header to connect pairs of socket contacts. In many uses, the standard insert 30 is mounted in a bay 40 of a mounting shell 42. The particular shell 42 is of a type that has three bays 40, 44, 46, with a rearwardly R facing shoulder 50 in each bay that engages a forwardly-facing shoulder 52 molded into the insert frame 32. The shell also has threaded holes 54 around each bay for mechanical connection to devices, and has flanges with unthreaded holes 56 for mounting the shell on other equipment.

In accordance with the present invention, applicant provides a quad terminator 60 which is terminated to the four conductors of the quad cable 12, and applicant also provides a backshell adaptor 62 that enables the four contacts of the quad terminator 60 to electrically connect to four pins 34 of the standard insert 30. Fig. 4 shows that the quad cable 12 includes four conductors 71-74, and four insulators 76-79, each insulator surrounding a conductor such as 71 along the length of the conductor (except where it is bared to make a connection). Fig. 2 shows that the quad terminator device, or quad terminator 60 has four contacts 82

that each has a rear end 84 that is terminated to a cable conductor such as 72 of the cable and that has a front end 86. The terminator has a terminator shell or main shield 90 with a step at 92, that encloses parts of the cable conductors such as 72 at front ends 84 of the contacts. The quad terminator also has four subshields 96 that each surrounds only one of the contacts 82. The subshields each have mating ends with tapered entrances 102 that can receive a pin end. The subshields 96 are preferably formed of stainless steel, and are separated from each other and from the main shield 90 by the insulation 94. It is noted that applicant's quad terminator 60 is largely similar to prior Quadrax connectors, except that the present quad terminator 60 is devoid of a main shield front end indicated at 104 that previously surrounded the mating ends of the contacts 86 and the mating ends of the subshields 96 that surround the contacts. Applicant's contact mating ends and subshields project forward of a front end 106 of the main shield 90 and of the insulator.

The backshell adaptor 62 shown in Fig. 1 has a plurality of bores 110 that are each constructed to receive and retain a quad terminator 60 of the construction shown in Fig. 2. It is noted that each bore 110 has a polarizing groove 112 that corresponds to a polarizing projection 114 in each quad terminator to fix the orientation of the terminator. The backshell adaptor has sideward projections 116 with fastener-receiving holes 120 that each receives a fastener 122 with a threaded end that can thread into a corresponding one of the hole 54 in the shell 42.

Fig. 3 illustrates the manner in which the insert is used to connect the terminals 14 of the connector 16, to the conductors such as 72 of the quad cable 12. The backshell adaptor 62 has a retainer 130, the particular retainer shown including the common clip type with resilient tines 140 that abut the rearwardly-facing shoulder 92 on the terminator main shell 90. When the quad terminator 60 is fully installed in the backshell adaptor 62, the mating ends 86 of the terminator contacts project forward of a front face 142 of the backshell adaptor, as do the subshields 96. When the backshell adaptor is mounted on the mounting shell 42,

the front face 142 of the backshell adaptor lies substantially facewise against a rear face 144 of the insert 30. By "substantially" applicant means that there is no more than a small gap between the faces 142, 144, which must be small enough to assure that the contact front mating ends 86 can fully engage the rear ends 150 of the pins 34 of the insert 30. Each pin 34 has rear and front ends 150, 152 and has a middle 154 that is captured in the insert frame 32. Applicant shows clips with tines 160 that releasably retain the pin middle portions. However, it is also possible to overmold the insert frame 32 around the pin middle portions to lock the pins in the frames.

As shown in Fig. 1, the insert frame 32 has multiple through passages 170 that each extends between the rear and front faces or ends 144, 146 of the insert frame. The standard insert 30 has one hundred-fifty passages arranged in ten horizontal rows and fifteen vertical columns, each passage normally holding a pin 34. The passages of each row are spaced at a pitch of 0.1 inch. As shown in Fig. 3, each terminator contact front end 86 and the subshield 96 that surrounds it, are each forwardly insertable into a rear end 172 of an insert passage 170. The passage front end 174 similarly receives a terminal 14 and a surrounding terminal subshield 20.

The backshell adaptor 62 of Fig. 1 has twelve bores 110 arranged in four horizontally-extending rows and three vertically-extending columns. Additional backshell adaptors can be used in connection with another insert lying in bay 46, and a double-length backshell adaptor can be used to hold two inserts in the two bays 40, 44.

Fig. 6 shows the outlines at 180, 182 of the main shields 90 of two quad connectors, or terminators 60, 60A whose contacts and the corresponding subshields have been inserted into passages 170 of the insert 30. The contacts and subshields of the first terminator 60 enter four passages of a first group 191 of four passages. The second terminator 60A, has contact rear ends that enter passages of a second group 192 of four passages. The two groups 191, 192 of four passages

each, must be separated sufficiently to at least account for the thickness of the walls between bores of the backshell adaptor. As a result, at least two passages 170A lie between the two groups 191, 192 of four passages each. Accordingly, applicant's backshell adaptor is provided with only twelve bores that hold twelve quad terminators, to engage pins in only forty-eight of the total of one hundred fifty passages 170 of the insert 30. The fact that one hundred two passages of the insert are not used, does not detract from the fact that the insert 30 is of much lower cost than a prior art special metal insert that was used.

The quad terminator 60 can be used to connect to substantially any equipment that previously connected to a Quadrax connector which was of similar design but with a main shield front end surrounding the projecting subshields and the contact front ends, except that the present grounded main shield 90 is not as accessible for a grounding connection.

Thus, the invention provides a connection system for connecting conductors of a quad cable to a device that includes socket contacts of a size (with subshields) that can enter passages in an insert. This is accomplished by terminating the cable conductors to contacts of a quad terminator that is similar to a prior Quadrax connector, but without a main shield front end. Also, a backshell adaptor is provided with bores that each receives and retains a quad terminator, with the rear ends of the contacts and of the subshields projecting from the front face of the backshell adaptor. The backshell adaptor, preferably with at least one quad terminator installed therein, is pressed towards a rear end of a standard insert until the front ends of the terminator contacts and the subshields around them, each enters a separate one of the insert passages, and the contacts mate to rear ends of double-ended contacts, such as double-ended pins, in the insert frame passages. The backshell adaptor is mounted in place, as by mounting it on a mounting shell with at least one bay that receives the insert.

The novel features of the invention are set forth with particularity in the appended claims. The invention will be best understood from the following

description when read in conjunction with the accompanying drawings.